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OCT 1988   TRAC—F—SP—0488

ACN 99996

COMBINED ARMS MODEL—ANTIARMOR MUNITIONS (CARMO—AM)
VERIFICATION AND VALIDATION (V&V) PLAN

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Fort Leavenworth

US ARMY
TRADOC ANALYSIS COMMAND—FORT LEAVENWORTH
(TRAC—FLVN)
FORCE ANALYSIS DIRECTORATE
FORT LEAVENWORTH, KANSAS 66027-5220

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TRADOC Analysis Command-Fort Leavenworth (TRAC-FLVN)
Force Analysis Directorate
Fort Leavenworth, Kansas 66027-5220

COMBINED ARMS MODEL-ANTIARMOR MUNITIONS (CARMO-AM)
VERIFICATION and VALIDATION (V&V)
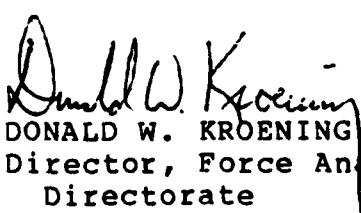PLAN

by

Jimi D. Whitten, Ph.D.

ACN 99996

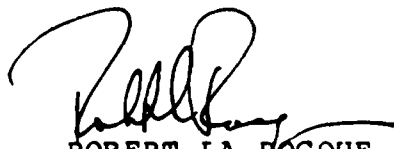PREPARED BY: CERTIFIED BY: APPROVED BY:

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REPORT DOCUMENTATION PAGE	Form Approved OMB No. 0704-0188

1a. REPORT SECURITY CLASSIFICATION Unclassified	1b. RESTRICTIVE MARKINGS None

2a. SECURITY CLASSIFICATION AUTHORITY	3. DISTRIBUTION/AVAILABILITY OF REPORT Approval for public release; distribution is unlimited.
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE NONE	

4. PERFORMING ORGANIZATION REPORT NUMBER(S) TRAC-F-SP-0488	5. MONITORING ORGANIZATION REPORT NUMBER(S)

6a. NAME OF PERFORMING ORGANIZATION USA TRADOC Analysis Command-Ft Leavenworth	6b. OFFICE SYMBOL (If applicable) ATRC-FFA	7a. NAME OF MONITORING ORGANIZATION

6c. ADDRESS (City, State, and ZIP Code) ATTN: ATRC-FFA (Whitten) Fort Leavenworth, KS 66027-5220	7b. ADDRESS (City, State, and ZIP Code)

8a. NAME OF FUNDING/SPONSORING ORGANIZATION USA TRADOC Analysis Command-Ft Leavenworth	8b. OFFICE SYMBOL (If applicable) ATRC-FFA	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER

8c. ADDRESS (City, State, and ZIP Code) ATTN: ATRC-FFA Fort Leavenworth, KS 66027-5220	10. SOURCE OF FUNDING NUMBERS			
	PROGRAM ELEMENT NO.	PROJECT NO.	TASK NO.	WORK UNIT ACCESSION NO.

11. TITLE (Include Security Classification)

Combined Arms Model-Antiarmor Munitions (CARMO-AM) Verification and Validation Plan

12. PERSONAL AUTHOR(S)
Whitten, Jimi D.

13a. TYPE OF REPORT	13b. TIME COVERED FROM Sep 88 TO Nov 88	14. DATE OF REPORT (Year, Month, Day) 1988 October	15. PAGE COUNT 13

16. SUPPLEMENTARY NOTATION

17. COSATI CODES			18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
FIELD	GROUP	SUB-GROUP	Verification, Validation, Modeling

19. ABSTRACT (Continue on reverse if necessary and identify by block number)

The verification and validation (V&V) of the Combined Arms Model-Antiarmor Munitions (CARMO-AM) was undertaken to determine the acceptability of the model for use as a quick turnaround tool at TRADOC Analysis Command-Fort Leavenworth. The V&V plan outlines all of the steps necessary in this effort. The V&V plan also states the support, resource, and administrative requirements.

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20. DISTRIBUTION/AVAILABILITY OF ABSTRACT ☒ UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT. ☐ DTIC USERS	21. ABSTRACT SECURITY CLASSIFICATION UNCLASSIFIED
22a. NAME OF RESPONSIBLE INDIVIDUAL Dr. Jimi D. Whitten	22b. TELEPHONE (Include Area Code) 913-684-2533/AV552-2533	22c. OFFICE SYMBOL ATRC-FFA

DD Form 1473, JUN 86	Previous editions are obsolete.	SECURITY CLASSIFICATION OF THIS PAGE

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ABSTRACT

The verification and validation (V&V) of the Combined Arms Model-Antiarmor Munitions (CARMO-AM) was undertaken to determine the acceptability of the model for use as a quick turnaround tool at TRADOC Analysis Command-Fort Leavenworth. The V&V plan outlines all of the steps necessary in this effort. The V&V plan also states the support, resource, and administrative requirements.

1. _Purpose_. This plan outlines the scope, schedule, essential elements of analysis (EEA), limitations, and required study resources to verify and validate (V&V) the Combined Arms Model-Antiarmor Munitions (CARMO-AM).

2. _References_. See appendix A.

3. _Terms of reference_.

   a. Problem. The TRADOC Analysis Command-Fort Leavenworth (TRAC-FLVN) needs a sound model which is neither time nor manpower intensive (a "quick turnaround" model) to assist in force design.

   b. Impact of problem. Models which have not been verified nor validated may produce questionable study results.

   c. Objectives. Verify and validate CARMO-AM to provide a sound "quick turnaround" model for force analysis. To produce a V&V CARMO-AM, the following steps are necessary.

      (1) For verification. Look at the integrity of the code and validity of methods used.

      (2) For validation. Compare the battle calculation results with the Bonder-Farrell attrition algorithm. Adjust and document, as necessary, any factors so that the results of CARMO-AM are reasonable and adequately represent combat operations. Examine the sensitivity of the model to changes in key parameters and examine the credibility of results.

   d. Scope. CARMO is limited to battalion engagements including supporting artillery and attack helicopters. Therefore, the V&V effort will focus on selected battalion battles and force structures consistent with those found in the Europe 6.3 scenario. This effort will focus on comparing direct fire results, but will consider indirect fire and air contributions.

   e. Limitations.

      (1) Nuclear, biological, and chemical (NBC) play will not be considered.

      (2) The direct fire engagements examined in the comparisons will use Blue task force organizations against Red regiments.

(3) The number of systems available to either side is eight.

f. Assumptions.

(1) A minimum of three potential targets are required for acquisition.

(2) The advance rate of attacking forces is an aggregate speed of ground force assault rates. This rate includes speed of march column, attack formations, and transition from march column to attack formation as the unit closes.

(3) Maneuver of individual platoons does not affect the final results of a battalion direct fire engagement.

g. Essential elements of analysis (EEA).

(1) Does CARMO-AM, with the same data base and scenario inputs, consistently produce similar results to the Bonder-Farrell algorithm?

(2) What are the causes of any major differences in the results?

(3) Does the program execute as described by the documentation?

(4) How sensitive is the model to changes in the following parameters?

- Terrain range (characterized terrain openness regarding line-of-sight probabilities).
- Acquisition range.
- System rates of fire.
- Advance rate.
- Target exposure factor (used to calculate probability of hit on exposed vulnerable areas).
- Target vantage parameters and weapon vantage parameters (these parameters account for differences in "advantage" in acquiring targets or avoiding detection among systems based on the situation, i.e., tank in overwatch verses assault role).
- Weapon accuracy parameters.

h. Measures of effectiveness (MOE). Given the same scenario and force structures, what are the differences in the following? (Additional MOE may be developed during the conduct of the study.)

(1) Direct fire loss exchange ratios and system exchange ratios.

(2) Friendly and enemy system losses (by class) with respect to time and killer.

(3) Percent of kills by killer or target category.

i. Methodology. CARMO uses an aggregate attrition methodology which runs in a gaming environment. Analysts will compare the model with a stand-alone version of the Bonder-Farrell methodology as applied in the Vector-In-Commander (VIC) model. As a framework for this comparison, force structures for Red and Blue forces will be used that are similar to those found in Europe 6.3. A set of battalion engagements from Europe 6.3 will be identified (those having primarily direct fire engagements since CARMO is a direct fire algorithm) and the results of these engagements will be compared with a similar set of CARMO engagements. Key factors collected from the VIC engagements will include missions of engaging forces, duration of engagement, number of elements involved in the engagement, and outcome of the engagement. Prior to the comparison of battalion engagements, the variance of selected input parameters will be examined. The analysis will consider both offensive and defensive situations.

j. Model. CARMO-AM is a force-on-force, deterministic model which uses a set of equations to calculate losses of each type weapon asset of the attacking and defending forces. The model allows the user to define the weapon systems of both defender and attacker in terms of range, acquisition probabilities, single shot hit and kill probabilities, and rates of fire. CARMO-AM was developed by CACI, Inc., and uses Lotus 1-2-3 spreadsheets.

k. Related studies are the Weapon Systems Capabilities Trade-off Analysis for Phase II, AirLand Battle-Future (ALB-F) study, and the Close Combat Heavy Analysis.

4. Environmental and threat considerations.

a. Conventional combat will be gamed with Blue task force organizations in defensive and offensive situations against motorized rifle and tank regiments.

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b. A European mid- to high-intensity environment is considered.

   c. This verification and validation plan will use systems and munitions consistent with those used in the Europe 6.3 scenario.

5. Support and resource requirements.

   a. Support requirements.

      (1) Force Analysis Directorate (FAD), TRADOC Analysis Command-Fort Leavenworth (TRAC-FLVN).

         (a) Provide plan.

         (b) Run the actual game and perform all analyses.

         (c) Write final report.

      (2) Model Support Directorate (MSD), TRAC-FLVN.

         (a) Perform the technical assessment of the model algorithms.

         (b) Provide a common data base converted for use in the CARMO-AM model and the Bonder-Farrell algorithm.

         (c) Provide a written report of the technical assessment of model algorithms.

      (3) Scenario and Doctrine Directorate (SDD), TRAC-FLVN, will provide copies of the Europe 6.3 scenario.

   b. Resource requirements. The CARMO-AM model runs on an IBM-compatible computer with a fixed disk drive system. Random access memory (RAM) requirement is 640 kilobytes (KB). The software requirement is Lotus 1-2-3, Version 2.01. These requirements are already available within FAD.

6. Data requirements. Data Management Section of MSD will provide 96/00 systems and munitions lists consistent with the data gamed in the Europe 6.3 scenario.

7. Administration.

    a. Schedule.   START DATE

	START DATE
(1) Literature search	Completed
(2) V&V plan	November 1988
(3) Preparation of CARMO-AM data bases	September 1988
(4) Technical assessment of algorithms	November 1988
(5) Gaming runs complete	December 1988
(6) Model comparison draft report complete	December 1988
(7) Final report complete	January 1989

    b. Review group membership and meeting   TBD
schedule

    c. Project officer. Dr. Jimi D. Whitten, FAD, AV 552-2533.

8. Correlation: ACN 99996.

9. Concurrence. The following agencies have participated in the preparation of this study plan and concur with it.

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OD	Mr. Ronald Magee	ATRC-FO	552-4367

APPENDIX A

REFERENCES

APPENDIX A

REFERENCES

1. CACI, Inc. Federal Resource and Systems Analysis Division. CARMO-AM Users Manual. Arlington, Virginia. January 1988.

2. Lawrence Livermore National Laboratory. JANUS Users Manual, Version 4.0. January 1988.

3. TRADOC Pamphlet 11-8. Studies and Analysis Handbook. 19 July 1985.

4. TRADOC Policy Letter. Models Configuration Control and Documentation. 10 March 1987.

APPENDIX B

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